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In 1980, the U.S. Agency for International Development initiated the AID Rural Satellite Program (RSP) to explore the potential of telecommunications as a means of extending scarce expert resources and expanding educational opportunities to remote and rural areas. Building on simple, interactive, and inexpensive telephone-based technologies, the Program developed teleconferencing systems for use as a development tool. Three pilot projects-in Indonesia, the West Indies, and Peru-were implemented to test and demonstrate that audioteleconferencing could reliably and affordably support development activities in education, health and agriculture.

In Indonesia and the West Indies, distance education programs were established with national universities. Linking 13 distant universities in Indonesia and six universities in the West Indies, an audioteleconferencing system was used to provide academic courses to university students, to upgrade faculty skills through in-service training programs, and to facilitate administrative and institutional communication. The effect was to make the expert resources of each institution available to all members of network, thus multiplying each professional's outreach and effectiveness. Over 15 courses were taught each semester to thousands of university students in Indonesia. The University of the West Indies trained over 500 doctors and nurses in 1985 and doubled the annual number of teaching certificates awarded because of expanded training opportunities offered by the teleconferencing system.

The experiences of the Rural Satellite Program in Indonesia, the West Indies, and Peru have shown that:

- Telecommunications can be adapted to provide affordable communications service in rural areas and provide a cost-effective means of extending social services to these areas.
- Telephone-based technologies can be made to operate reliably in the developing world. The Rural Satellite Program pilot project network operated at 90 to 98 percent reliability rate.
- Teleconferencing, specifically audioconferencing, was shown to be an effective means of providing quality of instruction and essential training to rural and isolated public service personnel.

Beyond these major research conclusions, the Program have afforded valuable lessons in the planning and implementation of distance education programs, the design of appropriate technical systems, the programmatic and technical

management by these programs, the process of technology transfer, and the identification of the most suitable uses and audiences.

The Development of the Indonesian Distance Education Satellite System (SISDIKSAT)

In 1978, in the eastern part of Indonesia, a group of rectors (presidents) of 10 government universities and teacher training institutes organized the Eastern Islands Universities Association, a cooperative working group whose aim was to promote the further development of its institutions through the sharing of ideas and resources. These rectors recognized that their institutions would not be able to advance rapidly enough through a policy of self-reliance.

Educational resources were scarce in the Eastern islands, and there was uneven development among institutions there. With only limited resources, the association started some modest programs such as periodic meetings of the rectors and the sharing of materials. With additional support from Jakarta they conducted a faculty exchange program, whereby a teacher from one institution would travel to another campus to teach one or more courses that were not available on that campus because of a lack of faculty.

Hasanuddin University

Other programs were started that involved sending students to Hasanuddin University or to the Agricultural Institute at Bogor on the island of Java for graduate study. Although these programs demonstrated that there was an established need for regular communications between sites, the universities had to rely primarily on mail and personal meetings to maintain those programs.

When the government decided to focus on "eastward-bound development" and allot additional resources to the Eastern islands, the government of Indonesia and UAID agreed to launch a five-year project to develop the agricultural expertise of the universities of eastern Indonesia. This project brought together Washington

State University (WSU), the USAID contractor, and the Eastern Islands Universities Association for the goal of strengthening the agricultural sector of the association through a variety of programs, including degree training programs in the U.S. for faculty and many workshops bringing together university personnel such as librarians and home economics teachers for the purposes of study, sharing and networking.

Discussion with AID's Bureau for Science and Technology about the Rural Satellite Program took place at the same time as consideration of an Indonesian open university. The Director General of Higher Education saw this as an opportunity for the Ministry of Education and Culture to explore the use of interactive telecommunications for distance education, both for the direct instruction of students and also for staff development and administrative activities. In determining where to establish such system, both he and USAID officials naturally looked to the eastern islands where there was an established association trying to share resources and a USAID project that was already in operation.

The first consideration was to specify the general type of communication system appropriate for the telecommunications needs of the prospective groups. In this case, the Association and the Directorate General of Higher Education were primarily interested in a two-way system that would unite the campuses. Because programming conceivably might originate at any of the sites, the Association stressed that all sites should be similar in their transmission and reception capabilities. The obvious communications option was a fully interactive conferencing system to link all of the campuses in the system, with each campus able to serve as an initiator of programming.

After assessing the interest and commitment of each of the institutions, the Directorate and the Association recommended that the satellite system consist of 11 sites linking nine of the 10 Association member institutions with the Directorate General in Jakarta and the Agricultural Institute at Bogor. The University of Halu Oleo (UNHALU) in Kendari was not included in the plan because it was a very new university fully occupied with its own development. After three years, however, INHALU got funds that enabled it to join the network in 1986. The 11 sites to be connected were, from east to west:

1. Cenderawasih University (UNCEN) in Jayapura
2. Cenderawasih University Agriculture Campus (UNCEN-M) in Manokwari
3. Pattimura University (UNPATTI) in Ambon
4. Sam Ratulangi University (UNSRAT) and the Institute of Education (IKIP) in Manado
5. Tadulako University (UNTAD) in Palu
6. Hasanuddin University (UNHAS) in Makassar
7. Institute of Education (IKIP) in Makassar
8. Mulawarman University (UNMUL) in Samarinda
9. Lambung Mankgurat University (UNLAM) in Banjarmasin

10. Directorate General of Higher Education (DIKTI) in Jakarta
11. Agricultural Institute (IPB) in Bogor

Later in the project, the twelfth site was added with the installation of a small, solar-powered station in the rural area of Wawatobi, Southeast Sulawesi, to provide the universities with the means to use telecommunications for rural development experiments.

After analyzing the needs and feasibility of the proposed telecommunication system with Perumtel (government-owned telecommunication company) and with higher education officials, it was decided that the best configuration of this system would be a two-channel, dedicated, audiographics system. The first channel would be an audioconferencing system connecting all sites in an open network: all would be tuned into the satellite channel at all times, and thus anything said at one location would be heard simultaneously at all other locations. The second channel would be used to provide a variety of services: graphics in support of the audio via facsimile and telewriting machines, private conferencing telephone facilities, and emergency backup to any failure of the audio channel. Both channels would be leased on a full-time basis.

Equipment	Number	Function
Telephone Terminal	1	Setting of transmit and receive levels for both channels; control of dialing functions and selection of equipment on Channel B
Audioconferencing: Channel A		
Convener	1	Setting of audio receive volume; voice switching
Microphones	12	Push-to-talk transmission of voice signal to all sites
Loudspeakers	2	Reception of voice signal from all sites
Graphic Support: Channel B		
Conferencing phone	1	Private calls on point-to-point or multipoint basis
Facsimile	1	Transfer of paper copy between sites
Telewriter	1	Microprocessor, modem, and light pen for transmission of handwriting or drawings
Monitors	3	19-inch monitor for telewriting directly on the screen with light pen; two 26-inch monitors for display of telewriting, video, or live television broadcasts

Signal coupler	1	Transfer of graphics signal from microprocessor to the 26-inch video display monitor
TV Tuner	1	Reception of off-air broadcast
Tape recorder	1	Taping audio or graphics signals and replaying pre-recorded graphics tapes
Emergency Power Supply		Backup power system consisting of rechargeable batteries, charger, voltage stabilizer, and inverter to supply electricity for the audioconferencing system for up to 12 hours without recharging

Table 1. Site Equipment

As a bi-national effort, SISDIKSAT was given the status of a national project. This meant that it had a temporary status with its funding coming totally from the national development budget rather than from the routine budget that finances permanent entities like the Directorate. In keeping with the government's policy of decentralization, it was decided to place the headquarters of SISDIKSAT in Makassar, South Sulawesi.

Reviews of Project Results

After the initial technical problems were overcome, the performance of the SISDIKSAT network became quite good. In the 1985-1986 academic year, only 10 (2.3 percent) of the 441 scheduled class sessions and none of the 28 faculty seminar programs were cancelled due to technical problems. The technical system actually performed better than the human system in that a much larger percentage of classes were cancelled because of teacher absences than technical failures. Even then, SISDIKSA's class completion rate was slightly better than those recorded for on-campus classes.

Student attendance fluctuated from week to week because of the general lack of emphasis on attendance in the university system and the irregular attendance of some local classes that used the SISDIKSAT courses as a supplementary activity. The average weekly attendance for a single course ran from 470 for a mandatory freshmen course to only 20 for a more specialized course. The average weekly attendance for all courses during the first three regular semesters ran from 1,200 to 2,500 students.

What did the students think of the course program?

Two major surveys of student attitudes toward the SISDIKSAT course program were made between August 1985 and June 1986. Responses were received from 2,286 students who had participated in courses during those two semesters. The students from both semesters generally held similar views. They felt that the

SISDIKSAT teachers were as good as or better than their on-campus resources and that the classes were well organized with sufficient time for interaction. Eighty to 90 percent of those students thought that the print materials had clear objectives and complemented the presentations over the satellite. Over 80% of the students from both semesters felt that the materials mere as good as or even better than their local materials.

Over 81 percent of the students surveyed thought that SISDIKSAT teachers were as good as or better than their local instructors. However, from August semester to the February semester there was a drop from 46% to 12% in the number of students who believed that SISDIKSAT teachers were better than their local instructors. In almost cases, the SISDIKSAT teachers had higher academic qualifications than local teaching staff so students were not using that as an indicator of better. It does not appear either that their evaluation were based on the dedication of the teachers nor by the degree of student interaction allowed by the teacher. Interviews with some classes indicated that many students preferred instructors who covered the course content at a leisurely pace that all students could follow. Perhaps the presentation styles and pace of the instructors affected the students' opinion.

The vast majority of students were also positive about the time for interaction on SISDIKSAT classes, and over 86% of them felt that the master teachers encouraged students to participate. Fifty-six percent of students reported that they had used microphones at least once during their course. Eight-five percent of those who had used the microphone used it to ask a question on the content of the lesson, and 15% had used it solely to ask about the organization of the course or to comment on the lecture.

Nevertheless, 59% of the students said that, given the option, they would prefer taking a face-to-face class over a satellite class. Only 19% said that they would prefer a SISDIKSAT class, and 22% were neutral. This probably reflects a natural human preference for a face-to-face instruction rather than a rejection of audioconferencing. Seventy percent of the respondents said that they learned as much as or more from SISDIKSAT classes than regular classes, while 30% felt they learned less.

Given the highly positive attitudes from participants in other SISDIKSAT programs, it appears that audioconferencing may be more popular with older learners with specific learning needs and good motivation. Professionals, field workers, and graduate students are probably a more suitable and appreciative audience for this type of system. They have a better idea of what they want to learn, strong motivation to learn it, and an appreciation of the expertise and opportunity that an audioconferencing can provide.

What were the reactions of the local tutors?

A survey was made of 43 tutors participating in the February semester, and interviews were held with most of them. Sixty-five percent said that they were present for all of the SISDIKSAT class sessions. All of the tutors reported having had at least one meeting with their students outside of the SISDIKSAT time, and the majority (63%) had held at least seven such meetings.

Seventy-four percent of the tutors believed that the syllabus of the SISDIKSAT course met the needs of their own institutions, and 83% of them thought that the course matched the needs of the Association. It was, however, almost impossible to make each course exactly fit the needs of each participating campus because each campus had slightly different needs and different types of students. The tutors felt that the materials were as good as (63%) or even better (37%) than that available locally, and all of them stated they would continue to use the materials for non-SISDIKSAT classes. Over 60% of the tutors believed that their students learned more from the SISDIKSAT course or at least the same (35%) as they would have in a regular course. Only 5% felt that their students learned less.

Furthermore, 86% felt that they had increased their ability to design and teach similar courses. Over 81% thought that this experience had increased their understanding of the course content, and 51% believed that it had increased their actual teaching skills. All of the tutors felt that they would now be able to teach the same course in a better way. When asked to choose one or more of four alternative uses of their particular SISDIKSAT course in their own institution, 86% of the tutors favored using the SISDIKSAT course as a required supplement for the regular campus course.

What were the reactions of the master teachers?

Another survey was undertaken of 20 faculty members who had served on SISDIKSAT course teams during 1985-1986 academic year. These teachers generally had higher academic qualifications and/or more teaching experience than most of the local tutors. Seventy percent of the master teachers held a master's or doctorate degree compared with the 21% of the tutors who had master's degree. Almost two thirds of the master teacher had more than 13 years of teaching experience; two thirds of the tutors had less than 13 years.

Three quarters of the SISDIKSAT teachers said that teaching over SISDIKSAT was more demanding than teaching regular classes. Compared with face-to-face classes, they said that they spent more time on materials preparation (55%) using a more detailed format (42%) and that they produced a greater amount of material (37%) for the satellite course. Although 95% of them stated that they utilized as much reading material or more for their SISDIKSAT class as for their regular classes, only 79% felt that the content was more complete than in their regular classes. All of the instructors said that they had made modifications in their normal teaching styles to suit SISDIKSAT.

A study to compare SISDIKSAT and regular classes was also conducted. The data show that SISDIKSAT classes averaged over 10 questions a class, and the regular classes averaged less than two. In addition, SISDIKSAT classes were much more likely to have time for interaction. Over 97% of the SISDIKSAT classes had time for student participation, but only 55% of the regular classes. While students in regular classes averaged one minute per class for questions on the content of the lessons, SISDIKSAT students averaged over eight minutes. These data show that SISDIKSAT students had more control over their classes.

Regarding their personal feelings toward SISDIKSAT and its programs, all instructors agreed that the offered courses were needed by the Association. Ninety-five percent said that they were quite comfortable teaching over the system with 85% stating that the equipment was easy to use, and 84% expressing satisfaction with the experience of teaching over SISDIKSAT.

Conclusion

Despite the great obstacles it faced as a complex and pioneering projects, SISDIKSAT was able to overcome most of the difficulties it encountered and successfully demonstrate and develop the use of interactive telecommunications as an effective tool for distance education.

In the technical area, the loopback design was shown to be a cost-efficient and effective basis for an audioconferencing network, and the gating system proved to be an innovative and workable response to the problem of telephone line noise. During its two-year demonstration phase, SISDIKSAT delivered a variety of programs to all of its member sites, including 60 academic courses and over 30 seminars. Over 10,000 people in the Eastern islands benefited from these interactive programs and the other services offered by SISDIKSAT. Textbooks and study guides were developed, and hundreds of master teachers and local tutors were introduced to new materials development and interactive reaching methods. Convinced of the value of SISDIKSAT, three additional institutions joined the network in 1986, thus increasing the total number of sites to 15.

Beyond its quantifiable accomplishments, SISDIKSAT also produced some additional benefits which are more difficult to assess. Hundreds of faculty members were given the opportunity to work with senior experts in their fields, provided with high quality materials, and given a role model to emulate. A concerted effort was made to increase the quality and standardization of courses within higher education institutions and increase the degree of student-teacher interaction in classes. Perumtel staff became familiar with the use of different types of equipment over the lines, the technical aspects of creating audioconferencing networks and given a functioning example of how the Palapa system could be used to meet their own administrative and training needs.

Most importantly, SISDIKSAT demonstrated that an audioconferencing network could be built in the Third World and used in a variety of ways for educational development. Both undergraduates and professionals in a wide range of fields received instruction and enthusiastically participated in discussion with distant experts. Academic courses, in-service training programs, meetings, and information exchange were carried out effectively. People in remote areas were given access to learning opportunities that otherwise would not have been available. Audioconferencing systems can provide developing countries with a powerful tool to extend educational opportunities to remote areas, to support and train professionals in the field, to share scarce human resources, and to enhance administrative efficiency. All countries posses a basic telecommunications infrastructure. SISIDIKSAT demonstrates that this existing technology and infrastructure can be used to help solve the problems of today and to prepare for a better tomorrow.

SISDIKSAT has shown that an auidoconferencsing system can be very successful under less than ideal conditions and that a developing country can use its own telecommunication facilities to help overcome of its problems. It is also true that "ideal" conditions will never be approximated until developing nations are given the experience of dealing with such technologies. SISDIKSAT has provided the Indonesian Government with that experience and has enhanced the chance that educational applications of interactive telecommunications system will be developed and successfully implemented in Indonesia and in other countries. The Rural Satellite Program has identified many problems that will be encountered whenever anyone seeks to use telecommunications services for distance education purposes, and its experience should help others to avoid or reduce many of those problems. The more important result of the Rural Satellite Program, however, has been to reveal the opportunities and achievements that can be realized when the power of telecommunications is used for educational goals. It is not a question of transferring high technology to the Third World but of using the high technology already there in innovative ways to promote human and national development.